"On the Effect of Temperature on Carbon-Dioxide Assimilation." By GABRIELLE L. C. MATTHAEI. Communicated by F. DARWIN, F.R.S. Received July 29, 1903.

(Abstract.)

1. The CO_2-assimilation of single cherry-laurel leaves has been determined through a range of temperature from – 6° to 45° C. The amount of CO_2 assimilated has been arrived at by the difference between the CO_2-content of a current of air before and after passing through the illuminated glass chamber containing the leaf.

At each temperature illumination of several different intensities has been employed in order to make certain that the amount of assimilation is not being limited by insufficient light. This has been neglected by previous investigators, and quite erroneous results have been put forward.

Taking this precaution, there is obtained for each temperature *a maximal assimilation specific to that temperature.* The amount of light required to produce the specific maximal assimilation varies directly with the magnitude of the maximum. When this is once reached, further increase in the illumination or in the amount of CO_2 supplied produces no longer any augmentation of the assimilation.

2. When a leaf is exposed to light of high intensity the absorbed excess of radiation raises the temperature of the leaf above that indicated by an adjacent thermometer. Under the conditions holding in these experiments, this excess sometimes amounted to as much as 10° C. It became, therefore, absolutely essential to know the effective internal temperature of the leaf. This has been determined by inserting a very fine thermo-electric junction into the substance of the leaf, and determining the temperature by means of a galvanometer at intervals throughout the assimilation experiment.

3. Care was taken that the leaves employed in these experiments should be all initially in the same condition, since ancillary researches had shown that differences in previous nutrition and temperature may be disturbing factors in the results obtained. The leaves to be employed were cut some time previously and kept, as a preliminary, under similar conditions of illumination and temperature.

In the course of the experiments it came out clearly that there are marked seasonal variations in the absolute assimilatory power of cherry-laurel leaves from the same individual plant.

4. For determining the "real assimilation" under any conditions a valuation of the concurrent respiratory CO_2-production is essential. At low temperatures the respiration is small in proportion to the assimilation, and slight errors in valuation are not significant. The

respiratory allowance could then be arrived at by determining the CO_2-production of a number of similar leaves in the dark.

At moderately high temperatures the respiration of the actual single leaf employed was determined, where possible, both before the assimilation experiment and after, when the CO_2-production is always much increased.

At the highest temperatures rapid decline of vitality made this procedure impossible, and only an approximate value could be arrived at.

5. Taking all these factors into consideration, a satisfactory series of assimilation maxima for the whole range of temperature was finally obtained.

The amount is just determinable at − 6° C., and then rises rapidly with higher temperatures, giving a curve which is convex to the temperature abscissa. The curve is similar to the accepted curves for the effect of temperature on respiration, and it rises more and more steeply at higher temperatures—certainly up to 38° C.

At temperatures about this point the leaf is not capable of maintaining its initial high rate of assimilation for any long time, so that the values obtained for successive hourly estimations with the same leaf form a rapidly declining series. The higher the temperature the shorter the duration of the period of maximal assimilation, and it becomes experimentally impossible with hourly estimations to obtain the maximal value at temperatures close to the fatal temperature of 45° C. The final numbers actually obtained, which can be only *sub*-maximal, show a conventional "optimum" at a temperature about 38° C., with a subsequent very rapid decline.